NOTICE

ON THE LAW OF THE

PRODUCTION OF SEXES

IN

PLANTS, ANIMALS, AND MEN.

BY

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MDCCCLXIII.
Printed by Odell and Ives, 18, Princes Street, Cavendish Square,
LONDON.

INTRODUCTION.

The question that is solved in this notice has been at all times a subject of investigation, yet it has hitherto remained unresolved. Thus it came to be the general belief that man was utterly powerless as regards the mysterious phenomenon of the production of sexes, and that any farther investigation would prove as useless as the former ones.

Still where there is no *a priori* impossibility, the fruitlessness of previous exertions is no evidence of the unavailableness of subsequent exertions. Owing to the continuous progress of science, many things may prove comparatively easy, that formerly were beyond the power of human minds.

If to this is objected the providential order that rules all created things and beings, which order is immutable, and should not, with propriety, be considered as likely to be disturbed by man, my answer will be as follows:—Nature's fundamental order is indeed immutable, but we should not take for such our more or less imperfect notions of the laws of Nature. I believe an apparent perturbation to characterise the passage in the real order from an inferior conception to a superior one.

The law of sexes, when applied to the animal kingdom, is productive of some practical effects which may be at once pointed out. Cattle breeders are enabled henceforward to obtain, according to their wishes, male or female animals. Now it is very seldom that it is the same for a cattle breeder to obtain a male or female animal. In each particular case, the advantage of obtaining the one rather than the other is tantamount to a certain sum of money. This is not the first instance of a purely scientific discovery becoming the means of an increase in the wealth of the community.

The author of the present discovery, the accuracy of which two years' experiments have already demonstrated, now offers it to be tried by the public at large.

This course of proceeding he looks upon as being the most safe, and such as to shield the public from any deceit.

LAW OF SEXES.—DEDUCTION.

Professor Lindley, in his book on the Theory of Horticulture, points out that, according to Knight's experiments, heat is favourable to the production of male flowers in diœcious plants, such as water melons and cucumbers.

I had long looked upon that fact as well worth being attended to, and, by considering its meaning in connection with General Physiology, I came to the following conclusions:—

Heat operates mediately on plants, by bringing on a more complete elaboration of the juices, and therefore a more thorough maturation of the organs. Thus the production of the male element answers to a more thorough maturation, otherwise to a more complete development of the organs. Such I deemed likely to be the meaning of Knight's experiments.

To enable us to apply to the animal kingdom those notions that originate in the vegetable one, we must compare the sexual marks and manifestations in both kingdoms. Most of the diœcious plants, at any rate those plants Knight experimented upon, are hermaphrodite, and become, as every botanist is aware, *diœcious* through abortion. Comparative anatomy of the male panicle and of the female ear in maize, which was one of my earliest botanical works, had long made me alive to the fact I have just mentioned. I felt fully satisfied that both the panicle and the ear in maize are constructed according to one single type, and that they show a like disposition in their organs, which differ only in the stage and mode of their growth and development. Most of the pistils of flowers in the panicle remain in a rudimental condition, as do the stamens of the flowers in the ear. As regards general growth, the male panicle expands rather in length, and the female ear rather in breadth; the panicle spreads, while the ear wraps itself in.

Thus, in many plants, diclinism is in some way accidental, and not, as it is in animals, deep seated and original. It is, therefore, much easier to study in plants than it is to study in animals those peculiar circumstances owing to which the male or the female element developes itself. Both elements in plants being, at first, nearly equal in power and as well balanced, small forces, easily mastered by the experimentalist, will be enough to turn the scale on either side, that is to bring forth one sex or the other.

What we have now to consider is, whether the forces that cause the development to take place, at a time when the sexes are already virtually determined, may be assimilated to those by which the original formation of sexes is governed. That assimilation would be looked upon as a probable fact, provided the fundamental identity of both sexes had been previously proved. Then would it not be unnaturally admitted that the force which, when at first operating on a neutral matter, determines the one sex or the other, is the very same force which by the protraction of its action evolves and completes whatever sex it has brought out. Thus to know the latter force would be knowing the former one. At any rate, before we look upon these forces as distinct, we had better ascertain that they are not to be considered as one. Natural philosophy objects to forces being uselessly multiplied.

In plants, the fundamental identity of stamens and of pistils is admitted by all botanists, who, with G. F. Wolff, Goethe, De Candolle, and Robert Brown, consider stamens and pistils as modified leaves. The inference to be drawn is the same, if believing with many a contemporary botanist, that an element belonging to the stem adds itself to that of the leaf, in order to form the pistil; that this is not connected with the fact of the pistil being a female organ, appears clearly through the accidental transformation of poppy stamens into well formed pistils.

Some anatomical investigations which in former years I undertook with Professor Hollard, made me positively convinced, that, in the animal kingdom, both male and female sexual apparatus are constructed upon one single plan, or according to one and the same type, which fact bears witness to their original identity and enables us to explain the characteristic discrepancies between both sexes, by mere harmonic discrepancies in the mode and quantity of the growth.

The probable determining causes of these harmonic discrepancies, are, according to Knight's experiments, to be looked for, in plants, amongst the causes that beget a more complete maturation of the organs. Now as sexual life belongs in common to animals and to plants, being, no doubt, in both kingdoms governed by fundamental laws that are materially identical, therefore the determining causes of sexual discrepancies in animals, will be those very causes that lead to a more complete maturation of the organs.

Thus there is a time in the animal's dark life, when the fact of a more complete development or a more finished maturation bears in favour of the male sex. The *secondary* determination of the sex may possibly take place, but at a late period in plants; still in both kingdoms the original determination is concealed in the dimness of original preformations.

In mankind the sex may be distinguished in the course of the second month following impregnation. Thus, in mankind, the moment at which the selection of the sex is made cannot but be included between the first development of the egg and the second month following impregnation ; whether however it precedes, follows, or is concomitant with impregnation, remains uncertain.

First, in order to know whether it precedes impregnation, the easiest plan would be to select the eggs of some oviparous animal, and then, other things being the same, the most complete development being found in the maturest eggs, to set apart the eggs according to their several ages, after which to fecundate them artificially, so as to see whether the oldest eggs will yield males. Perhaps a still easier experiment would be sufficient, viz., to observe in animals in which the eggs are fecundated on their way after having left the ovaries, whether males are yielded by the last eggs in each particular laying, which eggs are likely to have had most time to mature.

Now such an observation has long ago been made by Huber. This eminent naturalist discovered that in bees, fecundation, when taking place early, generates females, whilst if later it always produces males. I had also some ground to believe, that in poultry, the cocks of the brood are from the last-laid eggs.

From the lack of time and of any proper accommodation, I had it not in my power to proceed with the like experiments on other animals. I therefore determined on attempting a decisive trial upon mammifers. It was my good fortune to find in the well famed farm of Montet, by the active and skilful co-operation of its manager, M. George Cornaz, the best conditions for success that I could possibly expect to meet with.

It is a well known fact, that mammalian ova get loose from the ovary at the beginning of the rut, and that they are in a condition to be fecundated as long as the period of heat lasts, that is, therefore, even when they have reached a comparatively mature point. Truly that period is short, but during the first stages of *genetic development*, when all the essential elements of the coming being are as yet undeveloped, the creative power is actively at work, and capital alterations follow each other in a very short time.

I therefore directed M. Cornaz to get his cows served in the beginning of the rut, in order to procure females, and at the end of the rut, to procure males. The result was such as I had foreseen. (See M. Cornaz's Notice.)

I may add that when the exact experiments recorded in the Notice were over, M. Cornaz, being desirous of obtaining chiefly heifers, merely directed his men to get the cows served in general at the first indications of heat in the animals. This direction was given by the way and as if little cared for, so as to avoid rousing the servants' attention. Nevertheless it did not fail to procure for M. Cornaz a far larger amount of females than of males.

The whole duration of the descent of the ovum into the fallopian tubes and uterus (from twenty-four to forty-eight hours with cows) is divided into two equal periods. If fecundated in the first period, the germ turns out a female ovum; if fecundated in the second period, the germ is a male ovum. The moment that severs the one period from the other, I will call the turning point (*moment de vire*).

The experiments at Montet had in view the verifying of the chief fact itself, together with its constancy in highly favourable circumstances No endeavour was made towards investigating the comparative duration of the two periods in the uterine existence of the ovum;

and those either external or organic circumstances by which that duration may be modified, were left unstudied. Perhaps it varies a good deal; perhaps in some females the genital apparatus may be so weak, that the egg cannot reach the second period of its normal development. Such females in such a condition would beget only females. With an opposite disposition, the female period in the egg would be shortened, and male conceptions more likely to occur. Facts of a similar description have been observed in the human species, but I know not whether they occur in the animal kingdom. Moreover, it is likely that the male's influence may alter the comparative duration of both periods, by modifying the female's organic state.

New observations will, some time or other, teach us what notions we are to entertain as regards the organic alterations that occur in the ovum within the uterine period, that is during the passing of the ovum through the fallopian tubes and the uterus. Those alterations with which an increase in the size of the ovum is concomitant, will be more carefully studied, when it is known what physiological points they are connected with.

It is only in the germ that any development, any evolution, if there be any, takes place. All such intermediate gradations between the two sexes, as might be conceived, cannot be realised in the actually existing being which is wholly male or female. Either fecundation ceases to be possible during the intermediate period, or, more probably, the regular progress of the maturation of the ovum brings about at a given time a sudden alteration, such for instance as occurs at the bursting of the germinal vesicule. In consequence of that sudden crisis, the germ hitherto a female ovum becomes a male one.

Let us besides bear in mind, that the modifications of the ovum are merely histological and chemical, and that they have no conformity whatever with those future organic conditions to which they are preparatory, or to bring about which they are requisite.

In the main, between two different harmonic systems there exists no harmonic transition. The transition would be the deformed being, the monster which nature in her regular course does not realise, and which she is enabled to avoid without snapping the bond of the regular succession of beings by means of the *critical* development. The moment of the crisis when the transition is hurried, is for the most part concealed in the utter darkness of the germ's life.

Thus, geological species have succeeded each other. Nature hurries on her destiny. She does not drag in those accumulations of endless periods and of shapeless productions which are often ascribed to her.

In the general meaning it conveys, the law of *critical* development is everywhere recorded, in nature and in history, and expresses itself by hope and by grief, by renewal and by death.

SUMMARY & PRACTICAL OBSERVATIONS.

First.—The sex depends upon the stage of maturation in the ovum at the time it is fecundated.

Second.—If the ovum has not reached a certain stage of maturation, then, if fecundated, it yields a female; if it has passed that stage, then, if fecundated, it yields a male.

Third.—When at the period of heat a single ovum gets loose from the ovary, slowly to descend into the genital tube, (uniparous animals,) it is enough that fecundation should take place at the beginning of the rut, in order to procure females, and at the end in order to procure males, as the turning point of the ovum regularly occurs during its course through the genital tube.

Fourth.—When several ova in succession get loose from the ovary during the same generative period, (multiparous and most oviparous animals,) then the first eggs are generally less developed and yield females; the last ones are more mature and yield males (bees, cocks). But if it so happens that a second generative period should succeed the first one, or that the external circumstances should be entirely altered, (as in *aphides*, during winter,) then it may be that the last eggs do not reach the higher stage of maturation and still yield females.

Other things being the same, the principle of sexuality is not so easily to be applied with multiparous as with uniparous animals.

Fifth.—In order to apply the above principles to the large mammifers, the experimentalist must notice first the course of the rut-appearances in the animal on which he intends to operate, so that he may be exactly aware of the rut's duration and indications, which not unfrequently vary in different animals.

Sixth.—It is obvious that no positive result can be expected when the indications of heat are uncertain or ambiguous. This is seldom the case with animals that are let free, but may happen with fattening or stabled cattle.

Seventh.—From the way in which the law that rules the production of sexes has been deduced, it follows that such a law is general and should be applicable to all organised beings, that is, to plants, to animals, and to mankind.*

We are carefully to distinguish the law itself, (Nos. 1 and 2 of the present summary,) which is absolute, from its more or less easy applications.

NOTICE BY M. GEORGE CORNAZ.

I, the undersigned, George Cornaz, manager to my late father, the President of the Suisse Romande Agricultural Society, M. A. Cornaz's estate, at Montet, Canton of Vaud, Switzerland, hereby testify to having, on the 18th of February 1861, received from Professor Thury of Geneva, confidential instructions, the object of which was experimentally to test the law by which the production of sexes in animals is ruled.

I availed myself, upon my herd, of cows of such information as M. Thury had imparted to me, and *I have at once and without the least difficulty obtained all the expected results.*

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* The time for the descent of the ovum, which time in women corresponds to the rut in animals, includes the first ten or twelve days following the menstrual periods. The duration of that period is rather variable.

In the first place, in twenty-two successive cases, I tried to procure heifers; my cows were of Schwytz breed and my bull a thorough-bred Durham: the breeders had heifers in request, whilst males did not sell excepting to butchers: *in every single case* I obtained the wished for result.

Having at a later period bought a thorough-bred Durham cow, it was of importance to me to obtain a new bull which should succeed the one I had paid very highly for, and without merely waiting for the chances of a male offspring.

I operated according to Professor Thury's instructions, and the event once more confirmed the truth of the process imparted to me. That process can be at once and very easily applied.

Besides obtaining my Durham bull, I obtained six other bulls, crossed Durham-Schwytzes, which I intended for working purposes. By selecting cows of the same coat and size, I procured well matched pairs of oxen. My herd contains forty cows of every age.

To sum up, I have made in all twenty-nine experiments conformably to the new process: in not one single case has it failed. The whole of the experiments have been made by myself, without any body interfering.

Pursuant to which I can declare, that I look upon Professor Thury's system as true and perfectly safe, and I trust that he will soon enable all cattle breeders and farmers to take advantage of a discovery which will regenerate the business of cattle breeding.

Made at Montet, the 10th of February, 1863.

(Signed) G. CORNAZ.

PRACTICAL INSTRUCTIONS,

To obtain at will, animals belonging to the one or to the other sex, in cattle of the bovine race.

First.—The course, character, indications, and duration of rut-appearances should be previously observed in the cow upon which it is proposed to experiment, as they vary a little according to each animal. It is a well known fact, for instance, that the duration of the rut varies in different cows from twenty-four to forty-eight and even a greater number of hours.

Second.—When, according to instruction No. 1, the experimenter knows well the cow he intends to experiment upon, he is to operate as follows :—

To procure an heifer, have the cow served at the first indications of rut.

To procure a bull, have the cow served at the end of rut time.

Third.—Those animals in which the indications of rut are loose and uncertain, as is frequently the case with fattened or shut-up cows, should be excluded from the trial. Animals living in the open air should be selected in preference. Sound animals and such as are in regular conditions should be chosen.

Fourth.—The same experiments may be tried upon horses, asses, sheep, goats, etc. Although hitherto untested as regards those animals, our theory promises with them the same results as have been obtained with cows.

(Signed) M. THURY.